General

Guideline Title

Diabetes (type 1 and type 2) in children and young people: diagnosis and management.

Bibliographic Source(s)

National Collaborating Centre for Women's and Children's Health. Diabetes (type 1 and type 2) in children and young people: diagnosis and management. London (UK): National Institute for Health and Care Excellence (NICE); 2015 Aug 26. 92 p. (NICE guideline; no. 18).

Guideline Status

This is the current release of the guideline.

This guideline updates a previous version: National Collaborating Centre for Women's and Children's Health. Type 1 diabetes: diagnosis and management of type 1 diabetes in children and young people. London (UK): Royal College of Obstetricians and Gynecologists; 2004 Sep. 199 p. [685 references]

This guideline meets NGC's 2013 (revised) inclusion criteria.

Regulatory Alert

FDA Warning/Regulatory Alert

Note from the National Guideline Clearinghouse: This guideline references a drug(s) for which important revised regulatory and/or warning information has been released.

- April 8, 2016 – Metformin-containing Drugs : The U.S. Food and Drug Administration (FDA) is requiring labeling changes regarding the recommendations for metformin-containing medicines for diabetes to expand metformin's use in certain patients with reduced kidney function. The current labeling strongly recommends against use of metformin in some patients whose kidneys do not work normally. FDA concluded, from the review of studies published in the medical literature, that metformin can be used safely in patients with mild impairment in kidney function and in some patients with moderate impairment in kidney function.

Recommendations

Major Recommendations

Note from the National Guideline Clearinghouse (NGC): This guideline was developed by the National Collaborating Centre for Women's and Children's Health (NCC-WCH), which is based at the Royal College of Obstetricians and Gynaecologists, on behalf of the National Institute for Health and Care Excellence (NICE). See the "Availability of Companion Documents" field for the full version of this guidance.

Recommendations are marked as [new 2015], [2015], [2004] or [2004, amended 2015]:

- [new 2015] indicates that the evidence has been reviewed and the recommendation has been added or updated.
- [2015] indicates that the evidence has been reviewed but no change has been made to the recommended action.
- [2004] indicates that the evidence has not been reviewed since 2004.
- [2004, amended 2015] indicates that the evidence has not been reviewed since 2004, but either changes have been made to the recommendation wording that change the meaning or NICE has made editorial changes to the original wording to clarify the action to be taken.

The wording used in the recommendations in this guideline (for example, words such as 'offer' and 'consider') denotes the certainty with which the recommendation is made (the strength of the recommendation) and is defined at the end of the "Major Recommendations" field.

Definitions for terms used in the guideline recommendations are detailed in the original guideline document.

Diagnosis

Be aware that the characteristics of type 1 diabetes in children and young people include:

- Hyperglycaemia (random plasma glucose more than 11 mmol/litre)
- Polyuria
- Polydipsia
- Weight loss
- Excessive tiredness [2004, amended 2015]

Refer children and young people with suspected type 1 diabetes immediately (on the same day) to a multidisciplinary paediatric diabetes team with the competencies needed to confirm diagnosis and to provide immediate care. [2004, amended 2015]

Confirm type 1 diabetes in children and young people using the plasma glucose criteria specified in the World Health Organization's 2006 report on the diagnosis and classification of diabetes mellitus. [2004, amended 2015]

When diagnosing diabetes in a child or young person, assume type 1 diabetes unless there are strong indications of type 2 diabetes, monogenic or mitochondrial diabetes (see recommendations below). [new 2015]

Think about the possibility of type 2 diabetes in children and young people with suspected diabetes who:

- Have a strong family history of type 2 diabetes
- Are obese at presentation
- Are of black or Asian family origin have no insulin requirement
- Have no insulin requirement, have an insulin requirement of less than 0.5 units/kg body weight/day after the partial remission phase
- Show evidence of insulin resistance (for example, acanthosis nigricans) [2004, amended 2015]

Think about the possibility of types of diabetes other than types 1 or 2 (such as other insulin resistance syndromes, or monogenic or mitochondrial diabetes) in children and young people with suspected diabetes who have any of the following features:

- Diabetes in the first year of life
- Rarely or never develop ketone bodies in the blood (ketonaemia) during episodes of hyperglycaemia
- Associated features, such as optic atrophy, retinitis pigmentosa, deafness, or another systemic illness or syndrome [2004, amended 2015]

Do not measure C-peptide and/or diabetes-specific autoantibody titres at initial presentation to distinguish type 1 diabetes from type 2 diabetes. [new 2015]

Consider measuring C-peptide after initial presentation if there is difficulty distinguishing type 1 diabetes from other types of diabetes. Be aware that C-peptide concentrations have better discriminative value the longer the interval between initial presentation and the test. [new 2015]

Perform genetic testing if atypical disease behaviour, clinical characteristics or family history suggest monogenic diabetes. [new 2015]

Type 1 Diabetes

Education and Information for Children and Young People with Type 1 Diabetes

Offer children and young people with type 1 diabetes and their family members or carers (as appropriate) a continuing programme of education from diagnosis. Ensure that the programme includes the following core topics:

- Insulin therapy, including its aims, how it works, its mode of delivery and dosage adjustment
- Blood glucose monitoring, including targets for blood glucose control (blood glucose and glycated haemoglobin [HbA1c] levels)
- The effects of diet, physical activity and intercurrent illness on blood glucose control
- Managing intercurrent illness ('sick-day rules', including monitoring of blood ketones [beta-hydroxybutyrate])
- Detecting and managing hypoglycaemia, hyperglycaemia and ketosis [new 2015]

Tailor the education programme to each child or young person with type 1 diabetes and their family members or carers (as appropriate), taking account of issues such as:

- Personal preferences
- Emotional wellbeing
- Age and maturity
- Cultural considerations
- Existing knowledge
- Current and future social circumstances
- Life goals [new 2015]

Encourage young people with type 1 diabetes to attend clinic 4 times a year because regular contact is associated with optimal blood glucose control. [2004, amended 2015]

Explain to children and young people with type 1 diabetes and their family members or carers (as appropriate) that like others they are advised to have:

- Regular dental examinations (see the NICE guideline on dental recall)
- An eye examination by an optician every 2 years [2004, amended 2015]

Encourage children and young people with type 1 diabetes and their family members or carers (as appropriate) to discuss any concerns and raise any questions they have with their diabetes team. [new 2015]

Give children and young people with type 1 diabetes and their family members or carers (as appropriate) information about local and/or national diabetes support groups and organisations, and the potential benefits of membership. Give this information after diagnosis and regularly afterwards. [2004, amended 2015]

Encourage children and young people with type 1 diabetes to wear or carry something that identifies them as having type 1 diabetes (for example, a bracelet). [2004]

Explain to children and young people with type 1 diabetes and their family members or carers (as appropriate) how to find information about government disability benefits. [2004, amended 2015]

Take particular care when communicating with and providing information to children and young people with type 1 diabetes if they and/or their family members or carers (as appropriate) have, for example, physical and sensory disabilities, or difficulties speaking or reading English. [2004]

Children and young people with type 1 diabetes wishing to participate in sports that may have particular risks for people with diabetes should be offered comprehensive advice by their diabetes team. Additional information may be available from local and/or national support groups and organisations, including sports organisations. [2004, amended 2015]

Offer education for children and young people with type 1 diabetes and their family members or carers (as appropriate) about the practical issues related to long-distance travel, such as when best to eat and inject insulin when travelling across time zones. [2004]

Smoking and Substance Misuse

Explain to children and young people with type 1 diabetes and their family members or carers (as appropriate) about general health problems associated with smoking and in particular the risks of developing vascular complications. [2004]

Encourage children and young people with type 1 diabetes not to start smoking. See also the NICE guidelines on preventing the uptake of smoking by children and young people and school-based interventions to prevent smoking. [2004, amended 2015]

Offer smoking cessation programmes to children and young people with type 1 diabetes who smoke. See also the NICE guidelines on brief interventions and referral for smoking cessation, smoking cessation services, harm reduction approaches to smoking, and smoking cessation in secondary care. [2004, amended 2015]

Explain to children and young people with type 1 diabetes and their family members or carers (as appropriate) about the general dangers of substance misuse and the possible effects on blood glucose control. [2004]

Immunisation

Explain to children and young people with type 1 diabetes and their family members or carers (as appropriate) that the Department of Health's Green Book recommends annual immunisation against influenza for children and young people with diabetes over the age of 6 months. [2004]

Explain to children and young people with type 1 diabetes and their family members or carers (as appropriate) that the Department of Health's Green Book recommends immunisation against pneumococcal infection for children and young people with diabetes who need insulin or oral hypoglycaemic medicines. [2004, amended 2015]

Insulin Therapy for Children and Young People with Type 1 Diabetes

While the insulin regimen should be individualised for each patient, there are 3 basic types of insulin regimen.

Multiple daily injection basal–bolus insulin regimens: injections of short-acting insulin or rapid-acting insulin analogue before meals, together with 1 or more separate daily injections of intermediate-acting insulin or long-acting insulin analogue.

Continuous subcutaneous insulin infusion (insulin pump therapy): a programmable pump and insulin storage device that gives a regular or continuous amount of insulin (usually a rapid-acting insulin analogue or short-acting insulin) by a subcutaneous needle or cannula.

One, two or three insulin injections per day: these are usually injections of short-acting insulin or rapid-acting insulin analogue mixed with intermediate-acting insulin.

Take into account the personal and family circumstances of the child or young person with type 1 diabetes and discuss their personal preferences with them and their family members or carers (as appropriate) when choosing an insulin regimen. [new 2015]

Offer children and young people with type 1 diabetes multiple daily injection basal–bolus insulin regimens from diagnosis. If a multiple daily injection regimen is not appropriate for a child or young person with type 1 diabetes, consider continuous subcutaneous insulin infusion (CSII or insulin pump) therapy as recommended in Continuous subcutaneous insulin infusion for the treatment of diabetes mellitus (NICE technology appraisal guidance 151). [new 2015]

Encourage children and young people with type 1 diabetes who are using multiple daily insulin injection regimens and their family members or carers (as appropriate) to adjust the insulin dose if appropriate after each blood glucose measurement. [2004, amended 2015]

Explain to children and young people with type 1 diabetes using multiple daily insulin injection regimens and their family members or carers (as appropriate) that injecting rapid-acting insulin analogues before eating (rather than after eating) reduces blood glucose levels after meals and helps to optimise blood glucose control. [2004, amended 2015]

Provide all children and young people with type 1 diabetes who are starting continuous subcutaneous insulin infusion (CSII or insulin pump) therapy and their family members or carers (as appropriate) with specific training in its use. Provide ongoing support from a specialist team, particularly in the period immediately after starting continuous subcutaneous insulin infusion. Specialist teams should agree a common core of advice for continuous subcutaneous insulin infusion users. [2004, amended 2015]

Encourage children and young people with type 1 diabetes who are using twice-daily injection regimens and their family members or carers (as appropriate) to adjust the insulin dose according to the general trend in pre-meal, bedtime and occasional night-time blood glucose. [2004, amended 2015]

Explain to children and young people with newly diagnosed type 1 diabetes and their family members or carers (as appropriate) that they may experience a partial remission phase (a 'honeymoon period') during which a low dosage of insulin (0.5 units/kg body weight/day) may be sufficient

to maintain an HbA1c level of less than 48 mmol/mol (6.5%). [2004, amended 2015]

Offer children and young people with type 1 diabetes a choice of insulin delivery systems that takes account of their insulin requirements and personal preferences. [2004]

Provide children and young people with type 1 diabetes with insulin injection needles that are of an appropriate length for their body fat. [2004, amended 2015]

Provide children and young people with type 1 diabetes and their family members or carers (as appropriate) with suitable containers for collecting used needles and other sharps. Arrangements should be available for the suitable disposal of these containers. See also "Safe Use and Disposal of Sharps" in the NGC summary of the NICE guideline Infection. Prevention and control of healthcare-associated infections in primary and community care. [new 2015]

Offer children and young people with type 1 diabetes a review of injection sites at each clinic visit. [2004, amended 2015]

Provide children and young people with type 1 diabetes with rapid-acting insulin analogues for use during intercurrent illness or episodes of hyperglycaemia. [new 2015]

If a child or young person with type 1 diabetes does not have optimal blood glucose control (see "Blood Glucose and HbA1c Targets and Monitoring for Children and Young People with Type 1 Diabetes"):

- Offer appropriate additional support such as increased contact frequency with their diabetes team, and
- If necessary, offer an alternative insulin regimen (multiple daily injections, continuous subcutaneous insulin infusion [CSII or insulin pump] therapy or once-, twice- or three-times daily mixed insulin injections). [new 2015]

Oral Medicines for Children and Young People with Type 1 Diabetes

Metformin in combination with insulin is suitable for use only within research studies because the effectiveness of this combined treatment in improving blood glucose control is uncertain. [2004]

Do not offer children and young people with type 1 diabetes acarbose or sulphonylureas (glibenclamide, gliclazide, glipizide, tolazamide or glyburide) in combination with insulin because they may increase the risk of hypoglycaemia without improving blood glucose control. [2004, amended 2015]

Dietary Management for Children and Young People with Type 1 Diabetes

Support children and young people with type 1 diabetes and their family members or carers (as appropriate) to develop a good working knowledge of nutrition and how it affects their diabetes. [new 2015]

Explain regularly to children and young people with type 1 diabetes and their family members or carers (as appropriate) how healthy eating (including eating foods with a low glycaemic index, fruit and vegetables, and appropriate types and amounts of fats) can reduce their risk of cardiovascular disease, and support them to adjust their food choices accordingly. [new 2015]

Take into account social and cultural considerations when providing advice on dietary management to children and young people with type 1 diabetes. [new 2015]

Explain to children and young people with type 1 diabetes and their family members or carers (as appropriate) that children and young people with type 1 diabetes have the same basic nutritional requirements as other children and young people. Children and young people's food should provide sufficient energy and nutrients for optimal growth and development. [2004, amended 2015]

Offer level 3 carbohydrate-counting education from diagnosis to children and young people with type 1 diabetes who are using a multiple daily insulin injection regimen or continuous subcutaneous insulin infusion (CSII or insulin pump) therapy, and to their family members or carers (as appropriate), and repeat the offer at intervals thereafter. Level 3 carbohydrate counting is defined as carbohydrate counting with adjustment of insulin dosage according to an insulin:carbohydrate ratio. [new 2015]

Offer children and young people with type 1 diabetes who are changing their insulin regimen, and their family members or carers (as appropriate), dietary advice tailored to the new treatment. [new 2015]

Offer children and young people with type 1 diabetes and their family members or carers (as appropriate) education about the practical problems associated with fasting and feasting. [2004, amended 2015]

Encourage children and young people with type 1 diabetes and their family members or carers (as appropriate) to discuss the nutritional composition and timing of snacks with their diabetes team. [new 2015]

Encourage children and young people with type 1 diabetes to eat at least 5 portions of fruit and vegetables each day. [new 2015]

Explain to children and young people with type 1 diabetes and their family members or carers (as appropriate) that a low glycaemic index diet may help to improve blood glucose control and reduce the risk of hyperglycaemic episodes. [new 2015]

Offer children and young people with type 1 diabetes and their family members or carers (as appropriate) advice and education to promote a low glycaemic index diet. [new 2015]

Offer children and young people with type 1 diabetes dietetic support to help optimise body weight and blood glucose control. [2004]

At each clinic visit for children and young people with type 1 diabetes measure height and weight and plot on an appropriate growth chart. Check for normal growth and/or significant changes in weight because these may reflect changes in blood glucose control. [2004, amended 2015]

Provide arrangements for weighing children and young people with type 1 diabetes that respect their privacy. [2004]

Exercise for Children and Young People with Type 1 Diabetes

Encourage all children and young people, including those with type 1 diabetes, to exercise on a regular basis because this reduces the risks of developing cardiovascular disease in the long term. [2004, amended 2015]

Explain to children and young people with type 1 diabetes and their family members or carers (as appropriate) that they can take part in all forms of exercise, provided that appropriate attention is given to changes in insulin and dietary management. [2004]

Explain to children and young people with type 1 diabetes and their family members or carers (as appropriate) about the effects of exercise on blood glucose levels and about strategies for avoiding hypo- or hyperglycaemia during or after physical activity. [2004, amended 2015]

Encourage children and young people with type 1 diabetes and their family members or carers (as appropriate) to monitor blood glucose levels before and after exercise so that they can:

- Identify when changes in insulin or food intake are necessary
- Learn the blood glucose response to different exercise conditions
- Be aware of exercise-induced hypoglycaemia
- Be aware that hypoglycaemia may occur several hours after prolonged exercise [2004, amended 2015]

Explain to children and young people with type 1 diabetes and their family members or carers (as appropriate) that additional carbohydrate should be consumed as appropriate to avoid hypoglycaemia and that carbohydrate-based foods should be readily available during and after exercise. [2004]

Explain to children and young people with type 1 diabetes and their family members or carers (as appropriate) that additional carbohydrate should be consumed if plasma glucose levels are less than 7 mmol/litre before exercise is undertaken. [2004, amended 2015]

Explain to children and young people with type 1 diabetes and their family members or carers (as appropriate) that changes in daily exercise patterns may require insulin dose and/or carbohydrate intake to be altered. [2004]

Blood Glucose and HbA1c Targets and Monitoring for Children and Young People with Type 1 Diabetes

Blood Glucose Targets

Explain to children and young people with type 1 diabetes and their family members or carers (as appropriate) that the optimal target ranges for short-term plasma glucose control are:

- Fasting plasma glucose level of 4–7 mmol/litre on waking
- A plasma glucose level of 4–7 mmol/litre before meals at other times of the day
- A plasma glucose level of 5–9 mmol/litre after meals
- A plasma glucose level of at least 5 mmol/litre when driving [new 2015]

For further details about driving, see the Driver and Vehicle Licensing Agency (DVLA) guidance for people with insulin-treated diabetes .

Explain to children and young people with type 1 diabetes and their family members or carers (as appropriate) that achieving and maintaining blood glucose levels towards the lower end of the target optimal ranges will help them to achieve the lowest attainable HbA1c. [new 2015]

Ensure that children and young people with type 1 diabetes do not experience problematic hypoglycaemia or undue emotional distress when achieving, or attempting to achieve, blood glucose and HbA1c targets. [new 2015]

Be aware that there may be conflict between children and young people with type 1 diabetes and their family members or carers about blood glucose and HbA1c targets, and that an agreed compromise may be needed. [new 2015]

Blood Glucose Monitoring

Advise children and young people with type 1 diabetes and their family members or carers (as appropriate) to routinely perform at least 5 capillary blood glucose tests per day. [new 2015]

Advise children and young people with type 1 diabetes and their family members or carers (as appropriate) that more frequent testing is often needed (for example with physical activity and during intercurrent illness), and ensure they have enough test strips for this. [new 2015]

Offer children and young people with type 1 diabetes and their family members or carers (as appropriate) a choice of equipment for monitoring capillary blood glucose, so they can optimise their blood glucose control in response to adjustment of insulin, diet and exercise. [2004]

Explain to children and young people with type 1 diabetes and their family members or carers (as appropriate) that blood glucose levels should be interpreted in the context of the 'whole child', which includes the social, emotional and physical environment. [2004]

Offer ongoing real-time continuous glucose monitoring with alarms to children and young people with type 1 diabetes who have:

- Frequent severe hypoglycaemia or
- Impaired awareness of hypoglycaemia associated with adverse consequences (for example, seizures or anxiety) or
- Inability to recognise, or communicate about, symptoms of hypoglycaemia (for example, because of cognitive or neurological disabilities). [new 2015]

Consider ongoing real-time continuous glucose monitoring for:

- Neonates, infants and pre-school children
- Children and young people who undertake high levels of physical activity (for example, sport at a regional, national or international level)
- Children and young people who have comorbidities (for example anorexia nervosa) or who are receiving treatments (for example corticosteroids) that can make blood glucose control difficult [new 2015]

Consider intermittent (real-time or retrospective) continuous glucose monitoring to help improve blood glucose control in children and young people who continue to have hyperglycaemia despite insulin adjustment and additional support. [new 2015]

HbA1c Targets and Monitoring

Use methods to measure HbA1c that have been calibrated according to International Federation of Clinical Chemistry (IFCC) standardisation. [new 2015]

Explain the benefits of safely achieving and maintaining the lowest attainable HbA1c to children and young people with type 1 diabetes and their family members or carers (as appropriate). [new 2015]

Explain to children and young people with type 1 diabetes and their family members or carers (as appropriate) that an HbA1c target level of 48 mmol/mol (6.5%) or lower is ideal to minimise the risk of long-term complications. [new 2015]

Explain to children and young people with type 1 diabetes who have an HbA1c level above the ideal target of 48 mmol/mol (6.5%) and their family members or carers (as appropriate) that any reduction in HbA1c level reduces the risk of long-term complications. [new 2015]

Agree an individualised lowest achievable HbA1c target with each child or young person with type 1 diabetes and their family members or carers (as appropriate), taking into account factors such as daily activities, individual life goals, complications, comorbidities and the risk of hypoglycaemia. [new 2015]

Support children and young people with type 1 diabetes and their family members or carers (as appropriate) to safely achieve and maintain their individual agreed HbA1c target level. [new 2015]

Offer children and young people with type 1 diabetes measurement of their HbA1c level 4 times a year (more frequent testing may be appropriate if there is concern about suboptimal blood glucose control). [2004, amended 2015]

Diabetes services should document the proportion of children and young people with type 1 diabetes in a service who achieve an HbA1c level of 53 mmol/mol (7%) or lower. [new 2015]

Hyperglycaemia, Blood Ketone Monitoring and Intercurrent Illness in Children and Young People with Type 1 Diabetes

Provide each child and young person with type 1 diabetes and their family members or carers (as appropriate) with clear individualised oral and written advice ('sick-day rules') about managing type 1 diabetes during intercurrent illness or episodes of hyperglycaemia, including:

- Monitoring blood glucose
- Monitoring and interpreting blood ketones (beta-hydroxybutyrate)
- Adjusting their insulin regimen
- Food and fluid intake
- When and where to seek further advice or help

Revisit the advice with the child or young person and their family members or carers (as appropriate) at least annually. [new 2015]

Offer children and young people with type 1 diabetes blood ketone testing strips and a meter, and advise them and their family members or carers (as appropriate) to test for ketonaemia if they are ill or have hyperglycaemia. [new 2015]

Explain to children and young people with type 1 diabetes and their family members or carers (as appropriate) that it is important to ensure that blood ketone testing strips are not used after the specified ('use-by') date. [new 2015]

Hypoglycaemia in Children and Young People with Type 1 Diabetes

Explain to children and young people with type 1 diabetes and their family members or carers (as appropriate) about strategies for avoiding and managing hypoglycaemia. [2004]

Offer education for children and young people with type 1 diabetes, their family members, carers, and schoolteachers about recognising and managing hypoglycaemia. [2004]

Explain to children and young people with type 1 diabetes and their family members or carers (as appropriate) that they should always have access to an immediate source of fast-acting glucose and blood glucose monitoring equipment for immediate confirmation and safe management of hypoglycaemia. [2004, amended 2015]

Family members or carers and, where appropriate, school nurses and other carers should be trained and equipped to give intramuscular glucagon for severe hypoglycaemia in an emergency. [2004, amended 2015]

Immediately treat mild to moderate hypoglycaemia in children and young people with type 1 diabetes as follows.

- Give fast-acting glucose (for example, 10–20 g) by mouth (liquid carbohydrate may be taken more easily than solid)
- Be aware that fast-acting glucose may need to be given in frequent small amounts, because hypoglycaemia can cause vomiting
- Recheck blood glucose levels within 15 minutes (fast-acting glucose should raise blood glucose levels within 5 to 15 minutes) and repeat fast-acting glucose if hypoglycaemia persists
- As symptoms improve or normoglycaemia is restored, give oral complex long-acting carbohydrate to maintain blood glucose levels, unless the child or young person is:
    - About to have a snack or meal
    - Receiving a continuous subcutaneous insulin infusion [2004, amended 2015]

Treat severe hypoglycaemia in children and young people with type 1 diabetes who are in hospital and in whom rapid intravenous access is possible by giving 10% intravenous glucose. Give a maximum dose of 500 mg/kg body weight (equivalent to a maximum of 5 ml/kg). [2004, amended 2015]

Treat severe hypoglycaemia in children and young people with type 1 diabetes who are not in hospital or who do not have rapid intravenous access available as follows.

- Use intramuscular glucagon or a concentrated oral glucose solution (for example Glucogel). Do not use oral glucose solution if the level of consciousness is reduced as this could be dangerous.

- If using intramuscular glucagon:
  - Give children and young people over 8 years old (or who weigh 25 kg or more) 1 mg glucagon.
  - Give children under 8 years old (or who weigh less than 25 kg) 500 micrograms of glucagon.
- Seek medical assistance if blood glucose levels do not respond or symptoms persist for more than 10 minutes.
- As symptoms improve or normoglycaemia is restored, and once the child or young person is sufficiently awake, give oral complex long-acting carbohydrate to maintain normal blood glucose levels.
- Recheck the blood glucose repeatedly in children and young people who have persistently reduced consciousness after a severe hypoglycaemic episode, to determine whether further glucose is needed. [2004, amended 2015]

Explain to young people with type 1 diabetes the effects of alcohol consumption on blood glucose control, and in particular that there is an increased risk of hypoglycaemia including hypoglycaemia while sleeping. [2004, amended 2015]

Explain to young people with type 1 diabetes who drink alcohol that they should:

- Eat food containing carbohydrate before and after drinking
- Monitor their blood glucose levels regularly and aim to keep the levels within the recommended range by eating food containing carbohydrate [2004]

Explain to children and young people with type 1 diabetes and their family members or carers (as appropriate) that when alcohol causes or contributes to the development of hypoglycaemia, glucagon may be ineffective in treating the hypoglycaemia and intravenous glucose will be required. [2004]

Diabetes teams should consider referring children and young people with type 1 diabetes who have frequent hypoglycaemia and/or recurrent seizures for assessment of cognitive function, particularly if these occur at a young age. [2004]

Difficulties with Maintaining Optimal Blood Glucose Control in Children and Young People with Type 1 Diabetes

Think about the possibility of non-adherence to therapy in children and young people with type 1 diabetes who have suboptimal blood glucose control, especially in adolescence. [2004, amended 2015]

Be aware that adolescence can be a period of worsening blood glucose control in young people with type 1 diabetes, which may in part be due to non-adherence to therapy. [2004]

Raise the issue of non-adherence to therapy with children and young people with type 1 diabetes and their family members or carers (as appropriate) in a sensitive manner. [2004]

Be aware of the possible negative psychological impact of setting targets that may be difficult for some children and young people with type 1 diabetes to achieve and maintain. [new 2015]

Surgery for Children and Young People with Type 1 Diabetes

Offer surgery to children and young people with type 1 diabetes only in centres that have dedicated paediatric facilities for caring for children and young people with diabetes. [2004]

All centres caring for children and young people with type 1 diabetes should have written protocols on safe surgery for children and young people. The protocols should be agreed between surgical and anaesthetic staff and the diabetes team. [2004]

Ensure that there is careful liaison between surgical, anaesthetic and diabetes teams before children and young people with type 1 diabetes are admitted to hospital for elective surgery and as soon as possible after admission for emergency surgery. [2004, amended 2015]

Psychological and Social Issues in Children and Young People with Type 1 Diabetes

Diabetes teams should be aware that children and young people with type 1 diabetes have a greater risk of emotional and behavioural difficulties. [2004, amended 2015]

Offer children and young people with type 1 diabetes and their family members or carers (as appropriate) emotional support after diagnosis, which should be tailored to their emotional, social, cultural and age-dependent needs. [2004]

Assess the emotional and psychological wellbeing of young people with type 1 diabetes who present with frequent episodes of diabetic ketoacidosis (DKA). [2004, amended 2015]

Be aware that a lack of adequate psychosocial support has a negative effect on various outcomes, including blood glucose control in children and young people with type 1 diabetes, and that it can also reduce their self-esteem. [2004, amended 2015]

Offer children and young people with type 1 diabetes and their family members or carers (as appropriate) timely and ongoing access to mental health professionals with an understanding of diabetes because they may experience psychological problems (such as anxiety, depression, behavioural and conduct disorders and family conflict) or psychosocial difficulties that can impact on the management of diabetes and wellbeing. [2004, amended 2015]

For the treatment of depression and antisocial behaviour and conduct disorders in children and young people with type 1 diabetes see the NGC summaries of the NICE guidelines Depression in children and young people: identification and management in primary, community and secondary care and Antisocial behaviour and conduct disorders in children and young people: recognition, intervention and management. [new 2015]

Diabetes teams should have appropriate access to mental health professionals to support them in psychological assessment and the delivery of psychosocial support. [2004]

Offer children and young people with type 1 diabetes who have behavioural or conduct disorders, and their family members or carers (as appropriate), access to appropriate mental health professionals. [2004]

Offer specific family-based behavioural interventions, such as behavioural family systems therapy, if there are difficulties with diabetes-related family conflict. [new 2015]

Consider a programme of behavioural intervention therapy or behavioural techniques for children and young people with type 1 diabetes in whom there are concerns about psychological wellbeing in order to improve:

- Health-related quality of life – for example, counselling or cognitive behavioural therapy (CBT), including CBT focused on quality of life
- Adherence to diabetes treatment – for example, motivational interviewing or multisystemic therapy
- Blood glucose control in children and young people with high HbA1c levels (HbA1c above 69 mmol/mol [8.5%]) – for example, multisystemic therapy [new 2015]

Offer screening for anxiety and depression to children and young people with type 1 diabetes who have persistently suboptimal blood glucose control. [2004]

Diabetes teams should be aware that children and young people with type 1 diabetes may develop anxiety and/or depression, particularly when difficulties in self-management arise in young people and children who have had type 1 diabetes for a long time. [2004]

Refer children and young people with type 1 diabetes and suspected anxiety and/or depression promptly to child mental health professionals. [2004]

Diabetes teams should be aware that children and young people with type 1 diabetes, in particular young women, have an increased risk of eating disorders. See also the NICE guideline on eating disorders . [2004, amended 2015]

Be aware that children and young people with type 1 diabetes who have eating disorders may have associated difficulties with:

- Suboptimal blood glucose control (both hyperglycaemia and hypoglycaemia)
- Symptoms of gastroparesis [2004, amended 2015]

For children and young people with type 1 diabetes in whom eating disorders are identified, offer joint management involving their diabetes team and child mental health professionals. [2004, amended 2015]

Monitoring for Complications and Associated Conditions of Type 1 Diabetes

Offer children and young people with type 1 diabetes monitoring for:

- Thyroid disease at diagnosis and annually thereafter until transfer to adult services
- Diabetic retinopathy annually from 12 years
- Moderately increased albuminuria (albumin:creatinine ratio [ACR] 3–30 mg/mmol; 'microalbuminuria') to detect diabetic kidney disease, annually from 12 years
- Hypertension annually from 12 years [new 2015]

For guidance on monitoring for coeliac disease in children and young people with type 1 diabetes, see the NGC summary of the NICE guideline Coeliac disease: recognition, assessment and management. [new 2015]

For guidance on managing foot problems in children and young people with type 1 diabetes, see the NGC summary of the NICE guideline Diabetic foot problems: prevention and management. [new 2015]

Be aware of the following rare complications and associated conditions when children and young people with type 1 diabetes attend clinic visits:

- Juvenile cataracts
- Necrobiosis lipoidica
- Addison's disease [2004, amended 2015]

Explain to children and young people with type 1 diabetes and their family members or carers (as appropriate) the importance of annual monitoring from 12 years for diabetic retinopathy and diabetic kidney disease. [new 2015]

Diabetic Retinopathy in Children and Young People with Type 1 Diabetes

Explain to children and young people with type 1 diabetes and their family members or carers (as appropriate) that:

- Monitoring for diabetic retinopathy begins at 12 years (see recommendation above) because diabetic retinopathy that needs treatment is extremely rare in children and young people under 12
- Background retinopathy is often found through monitoring, and improving blood glucose control will reduce the risk of this progressing to significant diabetic retinopathy
- Annual monitoring from 12 years is important because, if significant diabetic retinopathy is found, early treatment will improve the outcome [new 2015]

Diabetic Kidney Disease in Children and Young People with Type 1 Diabetes

Explain to children and young people with type 1 diabetes and their family members or carers (as appropriate) that:

- Monitoring for moderately increased albuminuria (albumin:creatinine ratio [ACR] 3–30 mg/mmol; 'microalbuminuria') to detect diabetic kidney disease begins at 12 years (see recommendation above) because diabetic kidney disease in children and young people under 12 is extremely rare
- Using the first urine sample of the day ('early morning urine') to screen for moderately increased albuminuria is important, as this reduces the risk of false positive results
- If moderately increased albuminuria is detected, improving blood glucose control will reduce the risk of this progressing to significant diabetic kidney disease
- Annual monitoring from 12 years is important because, if diabetic kidney disease is found, early treatment will improve the outcome [new 2015]

Use the first urine sample of the day ('early morning urine') to measure the albumin:creatinine ratio. If the first urine sample of the day is not available, use a random sample, but be aware that this is associated with an increased risk of false positive results. [new 2015]

If the initial albumin:creatinine ratio is above 3 mg/mmol but below 30 mg/mmol, confirm the result by repeating the test on 2 further occasions using first urine samples of the day ('early morning urine') before starting further investigation and therapy. [new 2015]

Investigate further if the initial albumin:creatinine ratio is 30 mg/mmol or more (proteinuria). [new 2015]

Type 2 Diabetes

Education and Information for Children and Young People with Type 2 Diabetes

Offer children and young people with type 2 diabetes and their family members or carers (as appropriate) a continuing programme of education from diagnosis. Ensure that the programme includes the following core topics:

- HbA1c monitoring and targets
- The effects of diet, physical activity, body weight and intercurrent illness on blood glucose control
- The aims of metformin therapy and possible adverse effects
- The complications of type 2 diabetes and how to prevent them [new 2015]

Tailor the education programme to each child or young person with type 2 diabetes and their family members or carers (as appropriate), taking account of issues such as:

- Personal preferences
- Emotional wellbeing
- Age and maturity
- Cultural considerations
- Existing knowledge
- Current and future social circumstances
- Life goals [new 2015]

Explain to children and young people with type 2 diabetes and their family members or carers (as appropriate) that like others they are advised to have:

- Regular dental examinations (see the NICE guideline on dental recall)
- An eye examination by an optician every 2 years [2004, amended 2015]

Encourage children and young people with type 2 diabetes and their family members or carers (as appropriate) to discuss any concerns and raise any questions they have with their diabetes team. [new 2015]

Give children and young people with type 2 diabetes and their family members or carers (as appropriate) information about local and/or national diabetes support groups and organisations, and the potential benefits of membership. Give this information after diagnosis and regularly afterwards. [2004, amended 2015]

Explain to children and young people with type 2 diabetes and their family members or carers (as appropriate) how to find information about possible government disability benefits. [2004, amended 2015]

Take particular care when communicating with and providing information to children and young people with type 2 diabetes if they and/or their family members or carers (as appropriate) have, for example, physical and sensory disabilities, or difficulties speaking or reading English. [2004, amended 2015]

Smoking and Substance Misuse

Explain to children and young people with type 2 diabetes and their family members or carers (as appropriate) about general health problems associated with smoking and in particular the risks of developing vascular complications. [2004, amended 2015]

Encourage children and young people with type 2 diabetes not to start smoking. See also the NICE guidelines on preventing the uptake of smoking by children and young people and school-based interventions to prevent smoking . [2004, amended 2015]

Offer smoking cessation programmes to children and young people with type 2 diabetes who smoke. See also the NICE guidelines on brief interventions and referral for smoking cessation , smoking cessation services , harm reduction approaches to smoking , and smoking cessation in secondary care . [2004, amended 2015]

Explain to children and young people with type 2 diabetes and their family members or carers (as appropriate) about the general dangers of substance misuse and the possible effects on blood glucose control. [2004, amended 2015]

Immunisation

Explain to children and young people with type 2 diabetes and their family members or carers (as appropriate) that the Department of Health's Green Book recommends annual immunisation against influenza for children and young people with diabetes. [2004, amended 2015]

Explain to children and young people with type 2 diabetes and their family members or carers (as appropriate) that the Department of Health's Green Book recommends immunisation against pneumococcal infection for children and young people with diabetes who need insulin or oral hypoglycaemic medicines. [2004, amended 2015]

Dietary Management for Children and Young People with Type 2 Diabetes

At each contact with a child or young person with type 2 diabetes who is overweight or obese, advise them and their family members or carers (as appropriate) about the benefits of physical activity and weight loss, and provide support towards achieving this. See also the NGC summaries of the NICE guidelines Maintaining a healthy weight and preventing excess weight gain among adults and children and Obesity: identification, assessment and management of overweight and obesity in children, young people and adults. [new 2015]

Offer children and young people with type 2 diabetes dietetic support to help optimise body weight and blood glucose control. [2004, amended 2015]

At each contact with a child or young person with type 2 diabetes, explain to them and their family members or carers (as appropriate) how healthy eating can help to:

- Reduce hyperglycaemia
- Reduce cardiovascular risk
- Promote weight loss (see recommendation above) [new 2015]

Provide dietary advice to children and young people with type 2 diabetes and their family members or carers (as appropriate) in a sensitive manner, taking into account the difficulties that many people encounter with weight reduction, and emphasise the additional advantages of healthy eating for blood glucose control and avoiding complications. [new 2015]

Take into account social and cultural considerations when providing advice on dietary management to children and young people with type 2 diabetes. [new 2015]

Encourage children and young people with type 2 diabetes to eat at least 5 portions of fruit and vegetables each day. [new 2015]

At each clinic visit for children and young people with type 2 diabetes:

- Measure height and weight and plot on an appropriate growth chart
- Calculate BMI

Check for normal growth and/or significant changes in weight because these may reflect changes in blood glucose control. [2004, amended 2015]

Provide arrangements for weighing children and young people with type 2 diabetes that respect their privacy. [2004, amended 2015]

Metformin

Offer standard-release metformin from diagnosis to children and young people with type 2 diabetes. [new 2015]

HbA1c Targets and Monitoring for Children and Young People with Type 2 Diabetes

Use methods to measure HbA1c that have been calibrated according to International Federation of Clinical Chemistry (IFCC) standardisation. [new 2015]

Explain to children and young people with type 2 diabetes and their family members or carers (as appropriate) that an HbA1c target level of 48 mmol/mol (6.5%) or lower is ideal to minimise the risk of long-term complications. [new 2015]

Explain to children and young people with type 2 diabetes who have an HbA1c level above the ideal target of 48 mmol/mol (6.5%) and their family members or carers (as appropriate) that any reduction in HbA1c level reduces the risk of long-term complications. [new 2015]

Explain the benefits of safely achieving and maintaining the lowest attainable HbA1c to children and young people with type 2 diabetes and their family members or carers (as appropriate). [new 2015]

Agree an individualised lowest achievable HbA1c target with each child or young person with type 2 diabetes and their family members or carers (as appropriate), taking into account factors such as daily activities, individual life goals, complications and comorbidities. [new 2015]

Measure HbA1c levels every 3 months in children and young people with type 2 diabetes. [new 2015]

Support children and young people with type 2 diabetes and their family members or carers (as appropriate) to safely achieve and maintain their individual agreed HbA1c target level. [new 2015]

Diabetes services should document the proportion of children and young people with type 2 diabetes in a service who achieve an HbA1c level of 53mmol/mol (7%) or lower. [new 2015]

Surgery for Children and Young People with Type 2 Diabetes

Offer surgery to children and young people with type 2 diabetes only in centres that have dedicated paediatric facilities for caring for children and young people with diabetes. [2004, amended 2015]

All centres caring for children and young people with type 2 diabetes should have written protocols on safe surgery for children and young people. The protocols should be agreed between surgical and anaesthetic staff and the diabetes team. [2004, amended 2015]

Psychological and Social Issues in Children and Young People with Type 2 Diabetes

Diabetes teams should be aware that children and young people with type 2 diabetes have a greater risk of emotional and behavioural difficulties. [2004, amended 2015]

Offer children and young people with type 2 diabetes and their family members or carers (as appropriate) emotional support after diagnosis, which should be tailored to their emotional, social, cultural and age-dependent needs. [2004, amended 2015]

Be aware that children and young people with type 2 diabetes have an increased risk of psychological conditions (for example anxiety, depression, behavioural and conduct disorders) and complex social factors (for example family conflict) that can affect their wellbeing and diabetes management. See also the NGC summaries of the NICE guidelines Depression in children and young people: identification and management in primary, community and secondary care and Antisocial behaviour and conduct disorders in children and young people: recognition, intervention and management. [new 2015]

Be aware that a lack of adequate psychosocial support has a negative effect on various outcomes, including blood glucose control in children and young people with type 2 diabetes, and that it can also reduce their self-esteem. [2004, amended 2015]

Offer children and young people with type 2 diabetes and their family members or carers (as appropriate) timely and ongoing access to mental health professionals with an understanding of diabetes because they may experience psychological problems (such as anxiety, depression, behavioural and conduct disorders and family conflict) or psychosocial difficulties that can impact on the management of diabetes and wellbeing. [2004, amended 2015]

For the treatment of depression and antisocial behaviour and conduct disorders in children and young people with type 2 diabetes see the NGC summaries of the NICE guidelines Depression in children and young people: identification and management in primary, community and secondary care and Antisocial behaviour and conduct disorders in children and young people: recognition, intervention and management. [new 2015]

Diabetes teams should have appropriate access to mental health professionals to support them in psychological assessment and the delivery of psychosocial support. [2004, amended 2015]

Offer screening for anxiety and depression to children and young people with type 2 diabetes who have persistently suboptimal blood glucose control. [2004, amended 2015]

Refer children and young people with type 2 diabetes and suspected anxiety and/or depression promptly to child mental health professionals. [2004, amended 2015]

Ensure that children and young people with type 2 diabetes and their family members or carers (as appropriate) have timely and ongoing access to mental health services when needed. [new 2015]

Monitoring for Complications and Associated Conditions of Type 2 Diabetes

Offer children and young people with type 2 diabetes annual monitoring for:

- Hypertension starting at diagnosis
- Dyslipidaemia starting at diagnosis
- Diabetic retinopathy from 12 years
- Moderately increased albuminuria (ACR 3–30 mg/mmol; 'microalbuminuria') to detect diabetic kidney disease, starting at diagnosis [new 2015]

For guidance on managing foot problems in children and young people with type 2 diabetes, see the NGC summary of the NICE guideline Diabetic foot problems: prevention and management. [new 2015]

Explain to children and young people with type 2 diabetes and their family members or carers (as appropriate) the importance of annual monitoring for hypertension, dyslipidaemia, diabetic retinopathy and diabetic kidney disease. [new 2015]

Hypertension in Children and Young People with Type 2 Diabetes

Explain to children and young people with type 2 diabetes and their family members or carers (as appropriate) that monitoring (see recommendation above) is important because if hypertension is found, early treatment will reduce the risk of complications. [new 2015]

Use a cuff large enough for the child or young person with type 2 diabetes when measuring blood pressure. [new 2015]

If repeated resting measurements are greater than the 95th percentile for age and sex, confirm hypertension using 24-hour ambulatory blood pressure monitoring before starting antihypertensive therapy. [new 2015]

Dyslipidaemia in Children and Young People with Type 2 Diabetes

Explain to children and young people with type 2 diabetes and their family members or carers (as appropriate) that monitoring (see recommendation above) is important because if dyslipidaemia is found, early treatment will reduce the risk of complications. [new 2015]

When monitoring for dyslipidaemia in children and young people with type 2 diabetes, measure total cholesterol, high-density lipoprotein (HDL) cholesterol, non-HDL cholesterol and triglyceride concentrations. [new 2015]

Confirm dyslipidaemia using a repeat sample (fasting or non-fasting) before deciding on further management strategies. [new 2015]

Diabetic Retinopathy in Children and Young People with Type 2 Diabetes

Explain to children and young people with type 2 diabetes and their family members or carers (as appropriate) that:

- Background retinopathy is often found through monitoring (see recommendation above), and improving blood glucose control will reduce the risk of this progressing to significant diabetic retinopathy
- Annual monitoring from 12 years is important because, if significant diabetic retinopathy is found, early treatment will improve the outcome [new 2015]

Consider referring children and young people with type 2 diabetes who are younger than 12 years to an ophthalmologist for retinal examination if blood glucose control is suboptimal. [new 2015]

Diabetic Kidney Disease in Children and Young People with Type 2 Diabetes

Explain to children and young people with type 2 diabetes and their family members or carers (as appropriate) that:

- Using the first urine sample of the day ('early morning urine') to screen for moderately increased albuminuria (ACR 3–30 mg/mmol; 'microalbuminuria') is important, as this reduces the risk of false positive results
- If moderately increased albuminuria is detected, improving blood glucose control will reduce the risk of this progressing to significant diabetic kidney disease
- Annual monitoring (see recommendation above) is important because, if diabetic kidney disease is found, early treatment will improve the outcome [new 2015]

Use the first urine sample of the day ('early morning urine') to measure the albumin:creatinine ratio. If the first urine sample of the day is not available, use a random sample, but be aware that this is associated with an increased risk of false positive results. [new 2015]

If the initial albumin:creatinine ratio is above 3 mg/mmol but below 30 mg/mmol, confirm the result by repeating the test on 2 further occasions using first urine samples of the day ('early morning urine') before starting further investigation and therapy. [new 2015]

Investigate further if the initial albumin:creatinine ratio is 30 mg/mmol or more (proteinuria). [new 2015]

Diabetic Ketoacidosis

Recognition, Referral and Diagnosis

Measure capillary blood glucose at presentation in children and young people without known diabetes who have increased thirst, polyuria, recent unexplained weight loss or excessive tiredness and any of the following:

- Nausea or vomiting
- Abdominal pain
- Hyperventilation
- Dehydration
- Reduced level of consciousness [new 2015]

If the plasma glucose level is above 11 mmol/litre in a child or young person without known diabetes, and they have symptoms that suggest DKA (see recommendation above), suspect DKA and immediately send them to a hospital with acute paediatric facilities. [new 2015]

Be aware that children and young people taking insulin for diabetes may develop DKA with normal blood glucose levels. [new 2015]

Suspect DKA even if the blood glucose is normal in a child or young person with known diabetes and any of following:

- Nausea or vomiting
- Abdominal pain
- Hyperventilation
- Dehydration
- Reduced level of consciousness [new 2015]

When DKA is suspected in a child or young person with known diabetes (see recommendation above) measure the blood ketones (beta-hydroxybutyrate), using a near-patient method if available. If the level is elevated, immediately send them to a hospital with acute paediatric facilities. [new 2015]

When DKA is suspected in a child or young person with known diabetes (see recommendation above) and it is not possible to measure the blood ketones (beta-hydroxybutyrate) using a near-patient method, immediately send them to a hospital with acute paediatric facilities. [new 2015]

If DKA is suspected or confirmed in a child or young person, explain to them and to their family members or carers (as appropriate) that DKA is a serious matter that needs urgent hospital assessment. [new 2015]

When a child or young person with suspected or known DKA arrives at hospital, measure their:

- Capillary blood glucose
- Capillary blood ketones (beta-hydroxybutyrate) if near-patient testing is available, or urine ketones if it is not
- Capillary or venous pH and bicarbonate [new 2015]

Diagnose DKA in children and young people with diabetes who have:

- Acidosis (indicated by blood pH below 7.3 or plasma bicarbonate below 18 mmol/litre)
- Ketonaemia (indicated by blood beta-hydroxybutyrate above 3 mmol/litre) or ketonuria (++ and above on the standard strip marking scale) [new 2015]

Diagnose severe DKA in children and young people with DKA who have a blood pH below 7.1. [new 2015]

Initial Management of Diabetic Ketoacidosis

Inform the responsible senior clinician once a diagnosis of DKA in a child or young person is made. [new 2015]

Explain to the child or young person with DKA and to their family members or carers (as appropriate) about their condition and the care that they may need. [new 2015]

When DKA is diagnosed in a child or young person in hospital, record their:

- Level of consciousness
- Vital signs (heart rate, blood pressure, temperature, respiratory rate [look for Kussmaul breathing])
- History of nausea or vomiting
- Clinical evidence of dehydration
- Body weight [new 2015]

When DKA is diagnosed in a child or young person in hospital, measure and record the capillary or venous:

- pH and partial pressure of carbon dioxide in arterial blood (pCO_2)
- Plasma sodium, potassium, urea and creatinine
- Plasma bicarbonate [new 2015]

Consider a near-patient blood ketone (beta-hydroxybutyrate) testing method for rapid diagnosis and monitoring of DKA in children and young people in hospital. [new 2015]

Children and young people with DKA should be cared for in a facility that can provide the level of monitoring and care for DKA specified in this guideline. [new 2015]

Children and young people with DKA should be cared for with one-to-one nursing either on a high-dependency unit (preferably a paediatric unit), or on a general paediatric ward, if:

- They are younger than 2 years or
- They have severe DKA (indicated by a blood pH below 7.1) [new 2015]

Think about inserting a nasogastric tube if a child or young person with DKA has a reduced level of consciousness and is vomiting, to reduce the risk of aspiration. [new 2015]

Seek urgent anaesthetic review and discuss with a paediatric critical care specialist if a child or young person with DKA cannot protect their airway because they have a reduced level of consciousness. [new 2015]

Discuss the use of inotropes with a paediatric critical care specialist if a child or young person with DKA is in hypotensive shock. [new 2015]

Think about sepsis in a child or young person with DKA who has any of the following:

- Fever or hypothermia
- Hypotension
- Refractory acidosis
- Lactic acidosis [new 2015]

Fluid and Insulin Therapy

Treat DKA with oral fluids and subcutaneous insulin only if the child or young person is alert, not nauseated or vomiting, and not clinically dehydrated. [new 2015]

If DKA is treated with oral fluids and subcutaneous insulin, ensure that the child or young person is recovering by monitoring for resolution of ketonaemia and acidosis. [new 2015]

Treat DKA with intravenous fluids and intravenous insulin if the child or young person is not alert, is nauseated or vomiting or is clinically dehydrated. [new 2015]

Do not give oral fluids to a child or young person who is receiving intravenous fluids for DKA unless ketosis is resolving, they are alert, and they are not nauseated or vomiting. [new 2015]

Do not give an intravenous fluid bolus to children and young people with mild or moderate DKA (indicated by a blood pH of 7.1 or above). [new 2015]

Do not routinely give an intravenous fluid bolus to a child or young person with severe DKA (indicated by a blood pH below 7.1). [new 2015]

Do not give more than one intravenous fluid bolus of 10 ml/kg 0.9% sodium chloride to a child or young person with severe DKA (indicated by a blood pH below 7.1) without discussion with the responsible senior paediatrician. [new 2015]

In children and young people with DKA, calculate their total fluid requirement for the first 48 hours by adding the estimated fluid deficit (see recommendation below) to the fluid maintenance requirement (see recommendation below). [new 2015]

When calculating the fluid requirement for children and young people with DKA, assume:

- A 5% fluid deficit in mild to moderate DKA (indicated by a blood pH of 7.1 or above)
- A 10% fluid deficit in severe DKA (indicated by a blood pH below 7.1) [new 2015]

Calculate the maintenance fluid requirement for children and young people with DKA using the following 'reduced volume' rules:

- If they weigh less than 10 kg, give 2 ml/kg/hour
- If they weigh between 10 and 40 kg, give 1 ml/kg/hour
- If they weigh more than 40 kg, give a fixed volume of 40 ml/hour

These are lower than standard fluid maintenance volumes because large fluid volumes are associated with an increased risk of cerebral oedema. [new 2015]

Aim to replace the fluid deficit evenly over the first 48 hours in children and young people with DKA, because faster rehydration is associated with an increased risk of cerebral oedema. [new 2015]

Use 0.9% sodium chloride without added glucose for both rehydration and maintenance fluid in children and young people with DKA until the plasma glucose concentration is below 14 mmol/litre. [new 2015]

Ensure that all fluids (except any initial bolus) administered to children and young people with DKA contain 40 mmol/litre potassium chloride, unless they have renal failure. [new 2015]

If more than 20 ml/kg of fluid has been given by intravenous bolus to a child or young person with DKA, subtract any additional bolus volumes from the total fluid calculation for the 48-hour period. [new 2015]

Do not give intravenous sodium bicarbonate to children and young people with DKA. [new 2015]

Think about inserting a urinary catheter if it is not possible to accurately measure urine output for a child or young person with DKA. [new 2015]

Do not give children and young people with DKA additional intravenous fluid to replace urinary losses. [new 2015]

Start an intravenous insulin infusion 1 to 2 hours after beginning intravenous fluid therapy in children and young people with DKA. [new 2015]

When treating DKA with intravenous insulin in children and young people, use a soluble insulin infusion at a dosage between 0.05 and 0.1 units/kg/hour. Do not give bolus doses of intravenous insulin. [new 2015]

If a child or young person with DKA is using insulin pump therapy, disconnect the pump when starting intravenous insulin therapy. [new 2015]

In discussion with a diabetes specialist, think about continuing subcutaneous basal insulin in a child or young person who was using a basal insulin before the onset of DKA. [new 2015]

Change fluids to 0.9% sodium chloride with 5% glucose and 40 mmol/litre potassium chloride once the plasma glucose concentration falls below 14 mmol/litre in children and young people with DKA. [new 2015]

If during treatment for DKA a child or young person's plasma glucose falls below 6 mmol/litre:

- Increase the glucose concentration of the intravenous fluid infusion, and
- If there is persisting ketosis, continue to give insulin at a dosage of least 0.05 units/kg/hour [new 2015]

If the blood beta-hydroxybutyrate level is not falling within 6 to 8 hours in a child or young person with DKA, think about increasing the insulin dosage to 0.1 units/kg/hour or greater. [new 2015]

Think about stopping intravenous fluid therapy for DKA in a child or young person if ketosis is resolving, they are alert, and they can take oral fluids without nausea or vomiting. [new 2015]

Do not change from intravenous insulin to subcutaneous insulin in a child or young person with DKA until ketosis is resolving, they are alert, and they can take oral fluids without nausea or vomiting. [new 2015]

Start subcutaneous insulin in a child or young person with DKA at least 30 minutes before stopping intravenous insulin. [new 2015]

For a child or young person with DKA who is using insulin pump therapy, restart the pump at least 60 minutes before stopping intravenous insulin. Change the insulin cartridge and infusion set, and insert the cannula into a new subcutaneous site. [new 2015]

Monitoring During Therapy

Monitor and record the following at least hourly in children and young people with DKA:

- Capillary blood glucose
- Vital signs (heart rate, blood pressure, temperature, respiratory rate [look for Kussmaul breathing])
- Fluid balance, with fluid input and output charts
- Level of consciousness (using the modified Glasgow coma scale) [new 2015]

Monitor and record the level of consciousness (using the modified Glasgow coma scale) and the heart rate (to detect bradycardia) every 30 minutes in:

- Children under 2 years with DKA
- Children and young people with severe DKA (indicated by a blood pH below 7.1)

This is because these children and young people are at increased risk of cerebral oedema. [new 2015]

Monitor children and young people receiving intravenous therapy for DKA using continuous electrocardiogram (ECG) to detect signs of hypokalaemia, including ST-segment depression and prominent U-waves. [new 2015]

Ensure that healthcare professionals performing the monitoring described in recommendations above know what to look for and when to seek advice. [new 2015]

At 2 hours after starting treatment, and then at least every 4 hours, carry out and record the results of the following blood tests in children and young people with DKA:

- Glucose (laboratory measurement)
- Blood pH and pCO_2
- Plasma sodium, potassium and urea
- Beta-hydroxybutyrate [new 2015]

A doctor involved in the care of the child or young person with DKA should review them face-to-face at diagnosis and then at least every 4 hours, and more frequently if:

- They are aged under 2 years
- They have severe DKA (indicated by a blood pH below 7.1)
- There are any other reasons for special concern [new 2015]

At each face-to-face review of children and young people with DKA, assess the following:

- Clinical status, including vital signs and neurological status
- Results of blood investigations
- Electrocardiogram (ECG) trace
- Cumulative fluid balance record [new 2015]

Update the child and young person with DKA and their family members or carers (as appropriate) regularly about their progress. [new 2015]

Complications of Diabetic Ketoacidosis

Cerebral Oedema

Immediately assess children and young people with DKA for suspected cerebral oedema if they have any of these early manifestations:

- Headache
- Agitation or irritability
- Unexpected fall in heart rate
- Increased blood pressure [new 2015]

If cerebral oedema is suspected in a child or young person with DKA, treat immediately with the most readily available of mannitol (20%, 0.5–1 g/kg over 10 to 15 minutes) or hypertonic sodium chloride (2.7%or 3%, 2.5–5 ml/kg over 10 to 15 minutes). [new 2015]

Immediately treat for cerebral oedema using the most readily available of mannitol (20%, 0.5–1 g/kg over 10 to 15 minutes) or hypertonic sodium chloride (2.7% or 3%, 2.5–5 ml/kg over 10 to 15 minutes) if a child or young person with DKA develops any of these signs:

- Deterioration in level of consciousness
- Abnormalities of breathing pattern, for example respiratory pauses
- Oculomotor palsies
- Pupillary inequality or dilatation [new 2015]

After starting treatment for cerebral oedema with mannitol or hypertonic sodium chloride in a child or young person with DKA, immediately seek specialist advice on further management, including which care setting would be best. [new 2015]

Hypokalaemia

If a child or young person with DKA develops hypokalaemia (potassium below 3 mmol/litre):

- Think about temporarily suspending the insulin infusion

- Discuss hypokalaemia management urgently with a paediatric critical care specialist, because a central venous catheter is needed for intravenous administration of potassium solutions above 40 mmol/litre [new 2015]

Venous Thromboembolic Disease

Be aware of the increased risk of venous thromboembolism in children and young people with DKA, especially those with central venous catheters. [new 2015]

Avoiding Future Episodes of Diabetic Ketoacidosis

After a child or young person with known diabetes has recovered from an episode of DKA, discuss with them and their family members or carers (if appropriate) the factors that may have led to the episode. [new 2015]

Think about the possibility of non-adherence to therapy in children and young people with established type 1 diabetes who present with DKA, especially if the DKA is recurrent. [2004, amended 2015]

Advise children and young people who have had an episode of DKA and their family members or carers (if appropriate) how to reduce the risk of future episodes. In particular, advise them of the importance of managing intercurrent illnesses. [new 2015]

Service Provision

Offer children and young people with diabetes an ongoing integrated package of care provided by a multidisciplinary paediatric diabetes team. To optimise the effectiveness of care and reduce the risk of complications, the diabetes team should include members with appropriate training in clinical, educational, dietetic, lifestyle, mental health and foot care aspects of diabetes for children and young people. [2004, amended 2015]

Offer children and young people with diabetes and their family members or carers (as appropriate) 24-hour access to advice from their diabetes team. [2004, amended 2015]

Involve children and young people with diabetes and their family members or carers (as appropriate) in making decisions about the package of care provided by their diabetes team. [2004, amended 2015]

At diagnosis, offer children and young people with diabetes home-based or inpatient management according to clinical need, family circumstances and wishes. Explain that home-based care with support from the local paediatric diabetes team (including 24-hour telephone access) is safe and as effective as inpatient initial management. [2004, amended 2015]

Offer initial inpatient management to children with diabetes who are aged under 2 years. [2004, amended 2015]

Think about initial inpatient management for children and young people with diabetes if there are social or emotional factors that would make home-based management inappropriate, or if they live a long distance from the hospital. [2004, amended 2015]

Diabetes teams should liaise regularly with school staff supervising children and young people with type 1 diabetes to provide appropriate diabetes education and practical information. [2004, amended 2015]

Record the details of children and young people with diabetes on a population-based, practice-based or clinic-based diabetes register. [2004, amended 2015]

Transition From Paediatric to Adult Care

Allow sufficient time for young people with diabetes to familiarise themselves with the practicalities of the transition from paediatric to adult services because this improves clinic attendance. [2004, amended 2015]

Agree specific local protocols for transferring young people with diabetes from paediatric to adult services. [2004, amended 2015]

Base the decision about the age of transfer to the adult service on the young person's physical development and emotional maturity, and local circumstances. [2004, amended 2015]

Ensure that transition from the paediatric service occurs at a time of relative stability in the young person's health and is coordinated with other life transitions. [2004, amended 2015]

Explain to young people with type 1 diabetes who are preparing for transition to adult services that some aspects of diabetes care will change at transition. [2004, amended 2015]

Definitions

Strength of Recommendations

Some recommendations can be made with more certainty than others. The Guideline Development Group (GDG) makes a recommendation based on the trade-off between the benefits and harms of an intervention, taking into account the quality of the underpinning evidence. For some interventions, the GDG is confident that, given the information it has looked at, most patients would choose the intervention. The wording used in the recommendations in this guideline denotes the certainty with which the recommendation is made (the strength of the recommendation).

Interventions That Must (or Must Not) Be Used

The GDG usually use 'must' or 'must not' only if there is a legal duty to apply the recommendation. Occasionally the GDG uses 'must' (or 'must not') if the consequences of not following the recommendation could be extremely serious or potentially life threatening.

Interventions That Should (or Should Not) Be Used – a 'Strong' Recommendation

The GDG uses 'offer' (and similar words such as 'refer' or 'advise') when confident that, for the vast majority of patients, an intervention will do more good than harm, and be cost effective. The GDG uses similar forms of words (for example, 'Do not offer…') when confident that an intervention will not be of benefit for most patients.

Interventions That Could Be Used

The GDG uses 'consider' when confident that an intervention will do more good than harm for most patients, and be cost effective, but other options may be similarly cost effective. The choice of intervention, and whether or not to have the intervention at all, is more likely to depend on the patient's values and preferences than for a strong recommendation, and so the healthcare professional should spend more time considering and discussing the options with the patient.

Recommendation Wording in Guideline Updates

NICE began using this approach to denote the strength of recommendations in guidelines that started development after publication of the 2009 version of The guidelines manual (January 2009) (see the "Availability of Companion Documents" field). This does not apply to any recommendations ending [2004]. In particular, for recommendations labelled [2004] and [2004, amended 2015] the word 'consider' may not necessarily be used to denote the strength of the recommendation.

Clinical Algorithm(s)

A National Institute for Health and Care Excellence (NICE) care pathway titled "Diabetes in children and young people overview" is available from the NICE Web site .

Scope

Disease/Condition(s)

Type 1 and type 2 diabetes and their complications and associated conditions, including diabetic ketoacidosis

Guideline Category

Counseling

Diagnosis

Evaluation

Management

Prevention

Screening

Treatment

Clinical Specialty

Endocrinology

Family Practice

Internal Medicine

Nutrition

Pediatrics

Intended Users

Advanced Practice Nurses

Dietitians

Health Care Providers

Hospitals

Nurses

Patients

Pharmacists

Physician Assistants

Physicians

Podiatrists

Psychologists/Non-physician Behavioral Health Clinicians

Public Health Departments

Social Workers

Guideline Objective(s)

To offer best practice advice on the care of children and young people with type 1 and type 2 diabetes

Target Population

Children and young people (younger than 18 years) with type 1 or type 2 diabetes

Interventions and Practices Considered

1. Awareness of and recognition of characteristics of type 1 and type 2 diabetes in children and young people
2. Selective measurement of C-peptide and diabetes-specific antibody titres
3. Genetic testing
4. Management of type 1 diabetes

- Providing education and information about diabetes
- Tailored program
- Encouraging children and young people not to smoke and explaining dangers/risks of smoking and substance misuse
- Immunisation against influenza and pneumococcal infection
- Individualised insulin regimens
- Metformin in combination with insulin (Note: acarbose or sulphonylureas are not recommended)
- Dietary management, including carbohydrate-counting education and education about low glycaemic index diet
- Encouraging exercise and monitoring blood glucose levels before and after exercise
- Establishing targets and monitoring blood glucose and glycated haemoglobin (HbA1c) levels
- Providing information and advice on self-monitoring blood glucose, blood ketones, adjusting insulin regimens, food/fluid intake, and when and where to seek help/advice
- Education concerning strategies for avoiding and managing hypoglycaemia
- Maintaining awareness of non-adherence to therapy
- Considerations for surgery, including liaison between surgical, anaesthetic, and diabetes teams
- Management of psychological and social issues
- Monitoring for complications and associated conditions, including thyroid disease, diabetic retinopathy, kidney disease, hypertension, coeliac disease, and foot problems

5. Management of type 2 diabetes
    - Providing education and information about diabetes
    - Encouraging children and young people not to smoke and explaining dangers/risks of smoking and substance misuse
    - Immunisation against influenza and pneumococcal infection
    - Dietary management
    - Standard-release metformin
    - Establishing targets and monitoring HbA1c levels
    - Considerations for surgery
    - Management of psychological and social issues
    - Monitoring for complications and associated conditions, including hypertension, dyslipidaemia, diabetic retinopathy, kidney disease, and foot problems
6. Management of diabetic ketoacidosis (DKA)
    - Recognition, referral, and diagnosis
    - Initial management
    - Fluid and insulin therapy
    - Monitoring during therapy
    - Managing complications
    - Avoiding future complications
7. Service provision
    - Ongoing integrated package of care provided by a multidisciplinary paediatric diabetes team
    - Transition from paediatric to adult care

Major Outcomes Considered

- Glycaemic control
- Any adverse effects of interventions used to manage type 1 or type 2 diabetes
- Health-related quality of life (validated questionnaire), for example, diabetes-specific health-related quality of life
- Complications of diabetes
- Mortality
- Psychological outcomes
- Patient satisfaction
- Cost-effectiveness

Note: The outcomes listed above are the "main outcomes" considered. See the full version of the guideline (see the "Availability of Companion Documents" field) for a complete list of outcomes considered for each of the review questions.

Methodology

Methods Used to Collect/Select the Evidence

Searches of Electronic Databases

Description of Methods Used to Collect/Select the Evidence

Note from the National Guideline Clearinghouse (NGC): This guideline was developed by the National Collaborating Centre for Women's and Children's Health (NCC-WCH) on behalf of the National Institute for Health and Care Excellence (NICE). See the "Availability of Companion Documents" field for the full version of this guidance.

Developing Review Questions and Protocols and Identifying Evidence

The Guideline Development Group (GDG) formulated review questions based on the scope (see Appendix B in the full version of the guideline) and prepared a protocol for each review question (see Appendix E in the full guideline appendices [see the "Availability of companion Documents" field]). These formed the starting point for systematic reviews of relevant evidence. Published evidence was identified by applying systematic search strategies (see Appendix F in the full guideline appendices) to the following databases: Medline (1946 onwards), EMBASE (1974 onwards), the Health Technology Assessment (HTA) database, and three Cochrane databases (Cochrane Central Register of Controlled Trials, Cochrane Database of Systematic Reviews, and the Database of Abstracts of Reviews of Effects). Searches to identify economic studies were undertaken using the above databases and the National Health Service Economic Evaluation Database (NHS EED). The Cumulative Index to Nursing and Allied Health Literature (CINAHL; 1980 onwards) and PsycINFO (1806 onwards) were searched for selected topics only (specifically, for review questions related to dietary advice and those related to psychological and/or behavioural interventions). Where possible, searches were limited to English-language only. Generic and specially developed search filters were used to identify particular study designs, such as randomised controlled trials (RCTs). There was no systematic attempt to search grey literature (conference abstracts, theses or unpublished trials), nor was hand searching of journals not indexed on the databases undertaken.

Towards the end of the guideline development process, the searches were updated and re-executed to include evidence published and indexed in the databases by August 26, 2014.

Selected searches were date-limited to capture evidence published since the searches for the 2004 guideline were completed (December 2003). Where searches were date-limited this is indicated in the corresponding review protocol (see Appendix F in the full guideline appendices) and relevant studies considered in the 2004 guideline were retained and included in GRADE evidence profiles. Date-limited searches were limited to January 2003 onwards to ensure that relevant articles published in or after December 2003 were identified (because some databases do not allow date-limited searches to be specified by a particular month, but only by a particular year).

Number of Source Documents

See Appendix G, Summary of Identified Studies, in the full guideline appendices (see the "Availability of Companion Documents" field) for number of included studies for each review question.

Methods Used to Assess the Quality and Strength of the Evidence

Weighting According to a Rating Scheme (Scheme Given)

Rating Scheme for the Strength of the Evidence

Overall Quality of Outcome Evidence in Grading of Recommendations Assessment, Development and Evaluation (GRADE)

High	Further research is very unlikely to change confidence in the estimate of effect.
Moderate	Further research is likely to have an important impact on confidence in the estimate of effect and may change the estimate.

Low	Further research is very likely to have an important impact on confidence in the estimate of effect and is likely to change the estimate.
Very low	Any estimate of effect is very uncertain.

Methods Used to Analyze the Evidence

Meta-Analysis

Review of Published Meta-Analyses

Systematic Review with Evidence Tables

Description of the Methods Used to Analyze the Evidence

Note from the National Guideline Clearinghouse (NGC): This guideline was developed by the National Collaborating Centre for Women's and Children's Health (NCC-WCH) on behalf of the National Institute for Health and Care Excellence (NICE). See the "Availability of Companion Documents" field for the full version of this guidance.

Reviewing and Synthesising Evidence

The number of studies identified for each review question is summarised in Appendix G in the full guideline appendices (see the "Availability of Companion Documents" field). Some studies were excluded from the guideline reviews because they did not meet inclusion criteria specified by the Guideline Development Group (GDG) (see Appendix H in the full guideline appendices). The characteristics of each included study were summarised in evidence tables for each review question (see Appendix I in the full guideline appendices).

Raw data, or odds ratios (ORs), relative risks (RRs) or hazard ratios, together with their 95% confidence intervals (CIs), from multivariate analyses were extracted from the articles where appropriate. Data for the outcomes defined in the review protocol are summarised in tables within the relevant evidence review. Full data for all the outcomes are presented in the evidence tables (see Appendix I in the full guideline appendices).

Evidence related to clinical effectiveness was synthesised and evaluated using the Grading of Recommendations Assessment, Development and Evaluation (GRADE) approach. Using this approach, the quality of the evidence identified for each outcome listed in the review protocol is assessed according to the factors listed below and an overall quality rating (very low, low, moderate or high) is assigned by combining the ratings for the individual factors.

- Study design (as an indicator of intrinsic bias; this determines the initial quality rating)
- Limitations in the design or execution of the study (including concealment of allocation, blinding, loss to follow up; these can reduce the quality rating)
- Inconsistency of effects across studies (this can reduce the quality rating)
- Indirectness (the extent to which the available evidence fails to address the specific review question; this can reduce the quality rating)
- Imprecision (this can reduce the quality rating)
- Other considerations (including large magnitude of effect, evidence of a dose-response relationship, or confounding variables likely to have reduced the magnitude of an effect; these can increase the quality rating in observational studies provided no downgrading for other features has occurred)

GRADE findings are presented in full in Appendix K in the full guideline appendices; abbreviated versions (summary of findings without the individual components of the quality assessment) are presented in the full version of the guideline.

The type of review question determines the highest level of evidence that may be sought to answer a question. For issues of therapy or treatment, this is a well conducted systematic review or meta-analysis of randomised controlled trials (RCTs) or an individual RCT. Where systematic reviews, meta analyses or individual RCTs were not identified, other appropriate experimental or observational studies were sought.

For diagnostic questions, studies evaluating the performance of the test were sought, and sensitivity, specificity and likelihood ratios for positive and negative test results (LR+ and LR–, respectively), were calculated or quoted where possible (see Table 10 in the full version of the guideline). Where a valuation of the effectiveness of the test in the clinical management of the condition was required, evidence from RCTs or cohort studies was considered optimal. NICE recommends using the Quality Assessment of Studies of Diagnostic Accuracy (QUADAS) methodology checklist to assess the quality of diagnostic studies (see the NICE guidelines manual [see the "Availability of Companion Documents" field]).

It is necessary to predetermine values for minimally important differences (MIDs) for outcomes in order to make an assessment of imprecision. The MIDs were discussed and agreed with the GDG before the reviews commenced. For dichotomous outcomes the defaults of +/- 0.25 for RRs and ORs relative to no effect (RR=1 or OR=1) were used and imprecision was graded according to the following three 'zones' for effect estimates: less than 0.75; 0.75 to 1.25; greater than 1.25. If the CI for a particular effect estimate was wholly within 1 of the zones then the outcome would be graded as having no serious imprecision; if the CI spanned 2 of the zones, the outcome would be graded as having 'serious imprecision'; and if the CI spanned all 3 zones, then the outcome would be graded as having 'very serious imprecision'.

Where outcomes were continuous variables the MID was agreed at the protocol stage with the GDG and used when judging whether observed differences between treatment groups were considered clinically important. As with dichotomous outcomes, zones for determining imprecision of effect estimates were defined and applied based on the value that would correspond to no effect (for example, a mean difference of zero) and then added or subtracted to the MID.

The body of evidence identified for each review question (or part of a review question) was presented in a GRADE evidence profile which summarised the quality of the evidence by outcome and the findings (pooled relative and absolute effect sizes and associated CIs). Where possible, the body of evidence corresponding to each outcome specified in the review protocol was subjected to quantitative meta-analysis. In such cases, pooled effect sizes were presented as pooled RRs, pooled ORs, or weighted mean differences (WMDs). By default, meta-analyses were conducted by fitting fixed effect models, but where statistically significant heterogeneity was identified random effects models were used. Where quantitative meta-analysis could not be undertaken (for example, because of heterogeneity in the included studies) the effect sizes reported in the included studies were presented for each individual study. Forest plots for meta-analyses conducted for the guideline are presented in Appendix J in the full guideline appendices.

See Section 3.2 of the full version of the guideline for additional information on minimally important differences for methods for the review question considering the effectiveness of C-peptide and antibody tests to distinguish between type 1 and type 2 diabetes.

Assessing Cost-effectiveness

The aims of the health economic input to the guideline were to inform the GDG of potential economic issues related to diagnosis and management of type 1 and type 2 diabetes in children and young people, and to ensure that recommendations represented a cost effective use of healthcare resources. Health economic evaluations aim to integrate data on benefits (ideally in terms of quality adjusted life years [QALYs]), harms and costs of different care options.

The GDG prioritised a number of review questions where it was thought that economic considerations would be particularly important in formulating recommendations. A single global systematic search for published economic evidence was undertaken to cover all clinical topics addressed in the guideline. For economic evaluations, no standard system of grading the quality of evidence exists and included papers were assessed using a quality assessment checklist based on good practice in economic evaluation. Reviews of the relevant published health economic literature are presented in Section 20 of the full version of the guideline and summarised alongside the relevant clinical effectiveness reviews.

Health economic considerations were aided by original economic analysis undertaken as part of the development process. For this guideline the areas prioritised for economic analysis were as follows:

- Effectiveness of structured education programmes for children and young people with type 1 diabetes
- Comparative effectiveness of multiple daily injections of insulin and mixed insulin injections in children and young people with type 1 diabetes
- Dietary advice based on carbohydrate counting in children 1 and young people with type 1 diabetes using multiple daily injections of insulin
- Frequency of capillary blood glucose (finger-prick) testing in children and young people with type 1 diabetes
- Comparative effectiveness of capillary blood glucose testing and continuous glucose monitoring in children and young people with type 1 diabetes
- Comparative effectiveness of continuous glucose monitoring performed intermittently and continuous glucose monitoring performed in real-time in children and young people with type 1 diabetes
- Comparative effectiveness of blood ketone monitoring and urine ketone monitoring for the prevention of diabetic ketoacidosis (DKA)

Original analysis was not undertaken for all these areas. For structured education programmes there was recently published economic evidence undertaken from a National Health Service (NHS) perspective. For continuous glucose monitoring the GDG's view was that the clinical evidence was not sufficiently robust to support a recommendation for routine use and therefore the group felt that modelling was not needed to aid recommendations. The health economic analyses that were undertaken are described in detail in Section 20 of the full version of the guideline.

Methods Used to Formulate the Recommendations

Expert Consensus

Expert Consensus (Delphi)

Expert Consensus (Nominal Group Technique)

Description of Methods Used to Formulate the Recommendations

Note from the National Guideline Clearinghouse (NGC): This guideline was developed by the National Collaborating Centre for Women's and Children's Health (NCC-WCH) on behalf of the National Institute for Health and Care Excellence (NICE). See the "Availability of Companion Documents" field for the full version of this guidance.

This guideline was commissioned by NICE and developed in accordance with the process outlined in the 2009 and 2012 editions of The guidelines manual (see the "Availability of Companion Documents" field). Table 9 in the full version of the guideline summarises the key stages of the process and which version was followed for each stage.

Information about the clinical areas covered by the guideline (and those that are excluded) is available in the scope of the guideline (reproduced in Appendix B in the full guideline appendices [see the "Availability of Companion Documents" field]). A list of registered stakeholder organisations is presented in Appendix C in the full guideline appendices.

Organisations with an interest in the diagnosis and management of diabetes in children and young people were encouraged to register as stakeholders for the guideline. Registered stakeholders were consulted throughout the guideline development process.

In accordance with NICE's Equality Scheme, ethnic and cultural considerations and factors relating to disabilities were considered by the Guideline Development Group (GDG) throughout the development process and specifically addressed in individual recommendations where relevant. Further information is available from: https://www.nice.org.uk/about/who-we-are/policies-and-procedures/nice-equality-scheme .

This is one of five NICE clinical guidelines that were developed in the same timescale to address diabetes care:

- 'Diabetes (type 1 and type 2) in children and young people: diagnosis and management' (developed by the NCC-WCH; this guideline)
- 'Diabetes in pregnancy: management of diabetes and its complications from preconception to the postnatal period (developed by the NCC-WCH) (See the NGC summary of the NICE guideline Diabetes in pregnancy: management of diabetes and its complications from preconception to the postnatal period.)
- 'Type 1 diabetes in adults: diagnosis and management' (developed by the National Clinical Guideline Centre [NCGC]) (See the NGC summary of the NICE guideline Type 1 diabetes in adults: diagnosis and management.)
- 'Type 2 diabetes in adults' (developed by the Internal Clinical Guidelines Programme, Centre for Clinical Practice, NICE)
- 'Diabetic foot problems: prevention and management' (developed by the Internal Clinical Guidelines Programme, Centre for Clinical Practice, NICE) (See the NGC summary of the NICE guideline Diabetic foot problems: prevention and management.)

NICE set up a steering committee to oversee the production of the 5 clinical guidelines. The group, which included the GDG's chairs, together with staff from the 3 guidance-producing centres and NICE identified and resolved gaps and overlaps across the different guidance topics to ensure that the final guidelines were complementary and consistent. The guidance producing centres shared systematic reviews and draft guideline outputs to facilitate this.

Evidence to Recommendations

For each review question recommendations for clinical care were derived using, and linked explicitly to, the evidence that supported them. In the first instance, informal consensus methods were used by the GDG to agree short clinical and, where appropriate, cost effectiveness evidence statements which were presented alongside the evidence profiles. Statements summarising the GDG's interpretation of the evidence and any extrapolation from the evidence used to form recommendations were also prepared to ensure transparency in the decision-making process. The criteria used in moving from evidence to recommendations were as follows:

- Relative value placed on the outcomes considered
- Consideration of the clinical benefits and harms
- Consideration of net health benefits and resource use
- Quality of the evidence
- Other considerations (including equalities issues)

In areas where no substantial clinical research evidence was identified the GDG considered other evidence-based guidelines and consensus statements or used their collective experience to identify good practice. The health economics justification in areas of the guideline where the use of NHS resources (interventions) was considered was based on GDG consensus in relation to the likely cost effectiveness implications of the recommendations. The GDG also identified areas where evidence to answer their review questions was lacking and used this information to formulate recommendations for future research.

Towards the end of the guideline development process formal consensus methods were used to consider all the clinical care recommendations and research recommendations that had been drafted previously, including those brought forward from the 2004 guideline. The GDG identified 10 'key priorities for implementation' (key recommendations) and 5 high priority research recommendations. The key priorities for implementation were those recommendations thought likely to have the biggest impact on the care of children and young people with type 1 or type 2 diabetes in the National Health Service (NHS) as a whole; they were selected using a variant of the nominal group technique (see the NICE guidelines manual). The priority research recommendations were selected in a similar way. Questions to be addressed through further research are listed in the relevant sections of the guideline. Further details, including a summary of why further research is important for topics covered by the scope of the 2015 update, and summaries of changes made to research recommendations contained in the 2004 guideline, are presented in Appendix L in the full guideline appendices.

During the selection of key priorities for implementation and key recommendations all GDG members had an opportunity to nominate clinical recommendations and research recommendations as potential priorities. The interests declared by GDG members did not impact on the eventual selection of key priorities for implementation or key research recommendations because the only potential conflict of interest (due to the diabetic ketoacidosis [DKA] subgroup chair's involvement in research related to when to start and stop intravenous insulin therapy for the management of DKA [see Section 18.4.4.1 in the full version of the guideline]) was unrelated to any of the recommendations nominated as potential priorities.

Specific Considerations for This Guideline

The guideline scope defines children and young people as those younger than 18 years. At the beginning of the development process the GDG agreed that for each review question the initial approach would be to include studies only if they reported results for people younger than 18 years. This approach was relaxed for a few review questions (for example, intravenous osmotic agents for the management of cerebral oedema) where otherwise there would have been very little or no evidence for the GDG to consider (these exceptions are noted in the corresponding review protocols). Additionally, the NICE clinical guidelines addressing care for adults with type 1 or type 2 diabetes ('Type 1 diabetes in adults' and 'Type 2 diabetes in adults') were available where evidence specific to children and young people was lacking and extrapolation from adult evidence or recommendations was agreed by the GDG to be appropriate, although in most cases the GDG used informal consensus to formulate recommendations where evidence specific to children and young people was lacking.

The outcomes presented in GRADE profiles were identified as priorities by the GDG during review protocol development. For most review questions, the GDG limited the number of outcomes to 7 from the outset, and all of these were regarded as being critical to the formulation of recommendations. For a few questions where prioritisation outcomes was more difficult the GDG initially identified more than 7 outcomes with a view to extracting data for those most frequently reported in the studies identified for inclusion; for these questions the body of evidence identified for consideration was subsequently found to be sufficiently small for all outcomes reported in the included studies and listed in the review protocols to be extracted for consideration by the GDG.

For review questions in which the level of glycated haemoglobin (HbA1c) was prioritised as an outcome evidence was extracted and presented in evidence tables and GRADE profiles using Diabetes Control and Complications Trial (DCCT) units (percentages) to allow inclusion of historical evidence. The GDG was, however, aware that current practice is to use International Federation of Clinical Chemistry (IFCC) units (mmol/mol) and these units were used when specific HbA1c levels were included in recommendations.

Rating Scheme for the Strength of the Recommendations

Strength of Recommendations

Some recommendations can be made with more certainty than others. The Guideline Development Group (GDG) makes a recommendation based on the trade-off between the benefits and harms of an intervention, taking into account the quality of the underpinning evidence. For some interventions, the GDG is confident that, given the information it has looked at, most patients would choose the intervention. The wording used in the recommendations in this guideline denotes the certainty with which the recommendation is made (the strength of the recommendation).

Interventions That Must (or Must Not) Be Used

The GDG usually use 'must' or 'must not' only if there is a legal duty to apply the recommendation. Occasionally the GDG uses 'must' (or 'must

not') if the consequences of not following the recommendation could be extremely serious or potentially life threatening.

Interventions That Should (or Should Not) Be Used – a 'Strong' Recommendation

The GDG uses 'offer' (and similar words such as 'refer' or 'advise') when confident that, for the vast majority of patients, an intervention will do more good than harm, and be cost effective. The GDG uses similar forms of words (for example, 'Do not offer…') when confident that an intervention will not be of benefit for most patients.

Interventions That Could Be Used

The GDG uses 'consider' when confident that an intervention will do more good than harm for most patients, and be cost effective, but other options may be similarly cost effective. The choice of intervention, and whether or not to have the intervention at all, is more likely to depend on the patient's values and preferences than for a strong recommendation, and so the healthcare professional should spend more time considering and discussing the options with the patient.

Recommendation Wording in Guideline Updates

NICE began using this approach to denote the strength of recommendations in guidelines that started development after publication of the 2009 version of The guidelines manual (January 2009) (see the "Availability of Companion Documents" field). This does not apply to any recommendations ending [2004]. In particular, for recommendations labelled [2004] and [2004, amended 2015] the word 'consider' may not necessarily be used to denote the strength of the recommendation.

Cost Analysis

Reviews of the relevant published health economic literature are presented in Section 20 of the full version of the guideline (see the "Availability of Companion Documents" field) and summarised alongside the relevant clinical effectiveness reviews. Health economic considerations were aided by original economic analysis undertaken as part of the development process.

Method of Guideline Validation

External Peer Review

Internal Peer Review

Description of Method of Guideline Validation

Stakeholder Involvement

Registered stakeholder organisations were invited to send representatives to a stakeholder scoping workshop and to comment on the draft scope and draft guideline for consultation. The Guideline Development Group (GDG) carefully considered and responded to all comments received from stakeholder organisations. The comments and responses were reviewed by the National Institute for Health and Care Excellence (NICE) in accordance with the NICE guideline development process.

Evidence Supporting the Recommendations

Type of Evidence Supporting the Recommendations

The type of evidence supporting the recommendations is not specifically stated.

Benefits/Harms of Implementing the Guideline Recommendations

Potential Benefits

The Guideline Development Group (GDG) believes that by implementing the strict blood glucose control recommended in this guideline, improvements can be made to diabetes care that reduce the impact of the condition on the future health of children and young people.

See the "Consideration of clinical benefits and harms" sections in the full version of the guideline (see the "Availability of Companion Documents" field) for additional details about benefits of specific interventions.

Potential Harms

- Trying to persuade children and young people to lose weight could be harmful to their self-esteem if weight loss targets set were not achievable.
- Adverse events are associated with insulin therapy, specifically hypoglycaemia and injections site reactions.
- The standard-release formulation tablets of metformin are difficult for some children and young people to swallow.
- The only potential harm associated with hypertension monitoring was potential misdiagnosis and ensuing unnecessary treatment.
- The only potential harm associated with dyslipidaemia monitoring was misdiagnosis and ensuing unnecessary treatment.
- As with all diagnostic tests, false-positive results presented a potential harm in terms of exposing those who received such results to unnecessary treatment and anxiety.

See the "Consideration of clinical benefits and harms" sections in the full version of the guideline (see the "Availability of Companion Documents" field) for additional details about harms of specific interventions.

Qualifying Statements

Qualifying Statements

- This guidance represents the view of the National Institute for Health and Care Excellence (NICE), which was arrived at after careful consideration of the evidence available. Healthcare professionals are expected to take it fully into account when exercising their clinical judgement. However, the guidance does not override the individual responsibility of healthcare professionals to make decisions appropriate to the circumstances of the individual patient, in consultation with the patient and/or guardian or carer, and informed by the summaries of product characteristics of any drugs.
- Implementation of this guidance is the responsibility of local commissioners and/or providers. Commissioners and providers are reminded that it is their responsibility to implement the guidance, in their local context, in light of their duties to have due regard to the need to eliminate unlawful discrimination, advance equality of opportunity and foster good relations. Nothing in this guidance should be interpreted in a way that would be inconsistent with compliance with those duties.
- The guideline will assume that prescribers will use a medicine's summary of product characteristics to inform decisions made with individual patients.
- See the "Person-centred care" section in the original guideline document for information about individual needs and preferences and transition of care.
- See the original guideline document for information on safeguarding children.

Implementation of the Guideline

Description of Implementation Strategy

Implementation tools and resources to help users put the guideline into practice are available (see also the "Availability of Companion Documents" field).

Key Priorities for Implementation

The following recommendations have been identified as priorities for implementation.

Education and Information for Children and Young People with Diabetes

Take particular care when communicating with and providing information to children and young people with type 1 and type 2 diabetes if they and/or their family members or carers (as appropriate) have, for example, physical and sensory disabilities, or difficulties speaking or reading English. [2004, amended 2015]

Insulin Therapy for Children and Young People with Type 1 Diabetes

Offer children and young people with type 1 diabetes multiple daily injection basal–bolus insulin regimens from diagnosis. If a multiple daily injection regimen is not appropriate for a child or young person with type 1 diabetes, consider continuous subcutaneous insulin infusion (CSII or insulin pump) therapy as recommended in Continuous subcutaneous insulin infusion for the treatment of diabetes mellitus (NICE technology appraisal guidance 151). [new 2015]

Dietary Management for Children and Young People with Type 1 Diabetes

Offer level 3 carbohydrate-counting education from diagnosis to children and young people with type 1 diabetes who are using a multiple daily insulin injection regimen or continuous subcutaneous insulin infusion (CSII or insulin pump) therapy, and to their family members or carers (as appropriate), and repeat the offer at intervals thereafter. Level 3 carbohydrate counting is defined as carbohydrate counting with adjustment of insulin dosage according to an insulin:carbohydrate ratio. [new 2015]

Blood Glucose and Glycated Haemoglobin (HbA1c) Targets and Monitoring for Children and Young People with Type 1 Diabetes

Advise children and young people with type 1 diabetes and their family members or carers (as appropriate) to routinely perform at least 5 capillary blood glucose tests per day.

Offer ongoing real-time continuous glucose monitoring with alarms to children and young people with type 1 diabetes who have:

- Frequent severe hypoglycaemia or
- Impaired awareness of hypoglycaemia associated with adverse consequences (for example, seizures or anxiety) or
- Inability to recognise, or communicate about, symptoms of hypoglycaemia (for example, because of cognitive or neurological disabilities).

Explain to children and young people with type 1 diabetes and their family members or carers (as appropriate) that an HbA1c target level of 48 mmol/mol (6.5%) or lower is ideal to minimise the risk of long-term complications. [new 2015]

Hyperglycaemia, Blood Ketone Monitoring and Intercurrent Illness in Children and Young People with Type 1 Diabetes

Offer children and young people with type 1 diabetes blood ketone testing strips and a meter, and advise them and their family members or carers (as appropriate) to test for ketonaemia if they are ill or have hyperglycaemia. [new 2015]

Psychological and Social Issues in Children and Young People with Diabetes

Offer children and young people with type 1 and type 2 diabetes and their family members or carers (as appropriate) timely and ongoing access to mental health professionals with an understanding of diabetes because they may experience psychological problems (such as anxiety, depression, behavioural and conduct disorders and family conflict) or psychosocial difficulties that can impact on the management of diabetes and wellbeing. [2004, amended 2015]

Diabetic Kidney Disease in Children and Young People with Type 2 Diabetes

Explain to children and young people with type 2 diabetes and their family members or carers (as appropriate) that:

- Using the first urine sample of the day ('early morning urine') to screen for moderately increased albuminuria (albumin:creatinine ratio [ACR] 3–30 mg/mmol; 'microalbuminuria') is important, as this reduces the risk of false positive results
- If moderately increased albuminuria is detected, improving blood glucose control will reduce the risk of this progressing to significant diabetic kidney disease
- Annual monitoring is important because, if diabetic kidney disease is found, early treatment will improve the outcome [new 2015]

Diabetic Ketoacidosis

Measure capillary blood glucose at presentation in children and young people without known diabetes who have increased thirst, polyuria, recent unexplained weight loss or excessive tiredness and any of the following:

- Nausea or vomiting
- Abdominal pain

- Hyperventilation
- Dehydration
- Reduced level of consciousness [new 2015]

Implementation Tools

Clinical Algorithm

Mobile Device Resources

Patient Resources

Resources

For information about availability, see the *Availability of Companion Documents* and *Patient Resources* fields below.

Institute of Medicine (IOM) National Healthcare Quality Report Categories

IOM Care Need

Living with Illness

Staying Healthy

IOM Domain

Effectiveness

Patient-centeredness

Identifying Information and Availability

Bibliographic Source(s)

National Collaborating Centre for Women's and Children's Health. Diabetes (type 1 and type 2) in children and young people: diagnosis and management. London (UK): National Institute for Health and Care Excellence (NICE); 2015 Aug 26. 92 p. (NICE guideline; no. 18).

Adaptation

Not applicable: The guideline was not adapted from another source.

Date Released

2004 Sep (revised 2015 Aug 26)

Guideline Developer(s)

National Collaborating Centre for Women's and Children's Health - National Government Agency [Non-U.S.]

Source(s) of Funding

National Institute for Health and Care Excellence (NICE)

Guideline Committee

Guideline Development Group (GDG)

Composition of Group That Authored the Guideline

Guideline Development Group Members: Jerry Wales (*Chair*), Senior Lecturer in Paediatric Endocrinology, Sheffield University and Honorary Consultant, Sheffield Children's Hospital NHS Foundation Trust (until November 2013), Service Group Director Endocrinology and Nephrology, Lady Cilento Children's Hospital, Brisbane, Australia (from August 2014); Francesca Annan, Paediatric Diabetes Dietitian and Diabetes Service Lead, Alder Hey Children's NHS Foundation Trust, Liverpool; Jo Dalton, Clinical Nurse Specialist – Paediatric Diabetes, Pump Outreach Team, Royal London Hospital, Bart's Health (until November 2014), Transitional Nurse Specialist – Diabetes, Poole General Hospital, Dorset (from December 2014); Jaqueline Double, Patient and carer member; Sarah Eaton, GP, York, North Yorkshire; Julie Edge (*Chair, DKA subgroup*), Consultant in Paediatric Diabetes, Oxford Children's Hospital; Nikhil Gokani, Patient and carer member; William Lamb, Consultant Paediatrician, Bishop Auckland General Hospital, County Durham (until September 2012), Consultant Paediatric Diabetologist, Great North Children's Hospital, Newcastle upon Tyne (from January 2012); Carol Metcalfe (member from June 2014), Lead Paediatric Diabetes Specialist Nurse, East Cheshire NHS Trust, Macclesfield; Claire Pesterfield (member until March 2014), Lead Paediatric Diabetes Specialist Nurse, Cambridge University Hospitals NHS Foundation Trust

Financial Disclosures/Conflicts of Interest

All Guideline Development Group (GDG) members' potential and actual conflicts of interest were recorded on declaration forms provided by the National Institute for Health and Care Excellence (NICE) (summarised in Appendix D in the full guideline appendices [see the "Availability of Companion Documents" field]). The Chair of the diabetic ketoacidosis (DKA) subgroup was an author of some studies considered by the group, and so group discussions that included consideration of such studies were chaired by the National Collaborating Centre for Women's and Children's Health (NCC-WCH) clinical director. These occasions are documented in relevant sections of the guideline. No other interests declared by GDG members constituted a material conflict of interest that would influence recommendations developed by the GDG. Note that the GDG chair and members, and the expert advisers to the GDG, were recruited under NICE's April 2007 code of conduct on declaring and dealing with conflicts of interest.

Guideline Status

This is the current release of the guideline.

This guideline updates a previous version: National Collaborating Centre for Women's and Children's Health. Type 1 diabetes: diagnosis and management of type 1 diabetes in children and young people. London (UK): Royal College of Obstetricians and Gynecologists; 2004 Sep. 199 p. [685 references]

This guideline meets NGC's 2013 (revised) inclusion criteria.

Guideline Availability

Available from the National Institute for Health and Care Excellence (NICE) Web site. Also available in ePub or eBook formats from the NICE Web site.

Availability of Companion Documents

The following are available:

- Diabetes (type 1 and type 2) in children and young people: diagnosis and management. Full guideline. London (UK): National Institute for Health and Care Excellence (NICE); 2014 Dec. 504 p. (NICE guideline; no. 18). Available from the National Institute for Health and Care Excellence (NICE) Web site .
- Diabetes (type 1 and type 2) in children and young people: diagnosis and management. Appendices A-N. London (UK): National Institute for Health and Care Excellence (NICE); 2015 Aug. 622 p. (NICE guideline; no. 18). Available from the NICE Web site .
- Diabetes (type 1 and type 2) in children and young people: diagnosis and management. Appendix I. London (UK): National Institute for Health and Care Excellence (NICE); 2015 Aug. 381 p. (NICE guideline; no. 18). Available from the NICE Web site .
- Diabetes (type 1 and type 2) in children and young people: diagnosis and management. Baseline assessment tool. London (UK): National Institute for Health and Care Excellence (NICE); 2015 Aug. (NICE guideline; no. 18). Available from the NICE Web site .
- Diabetes (type 1 and type 2) in children and young people: diagnosis and management. Costing statement. London (UK): National Institute for Health and Care Excellence (NICE); 2015 Aug. 9 p. (NICE guideline; no. 18). Available from the NICE Web site .
- The guidelines manual 2012. London (UK): National Institute for Health and Care Excellence (NICE); 2012 Nov. Available from the NICE Web site .

Patient Resources

The following is available:

- Diabetes (type 1 and type 2) in children and young people: diagnosis and management. Information for the public. London (UK): National Institute for Care Excellence (NICE), 2015 Aug. (NICE guideline; no. 18). Available from the National Institute for Health and Care Excellence (NICE) Web site .

Please note: This patient information is intended to provide health professionals with information to share with their patients to help them better understand their health and their diagnosed disorders. By providing access to this patient information, it is not the intention of NGC to provide specific medical advice for particular patients. Rather we urge patients and their representatives to review this material and then to consult with a licensed health professional for evaluation of treatment options suitable for them as well as for diagnosis and answers to their personal medical questions. This patient information has been derived and prepared from a guideline for health care professionals included on NGC by the authors or publishers of that original guideline. The patient information is not reviewed by NGC to establish whether or not it accurately reflects the original guideline's content.

NGC Status

This NGC summary was completed by ECRI on March 7, 2005. The information was verified by the guideline developer on February 20, 2006. This summary was updated by ECRI Institute on November 13, 2015. This summary was updated by ECRI Institute on April 15, 2016 following the U.S. Food and Drug Administration advisory on Metformin-containing Drugs.

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